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Tracking the history of metal smelting in Southeastern Europe throughout the Holocene

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The exploitation of mineral resources, an essential driver of societal development, also induces long lasting impacts on the global ecosystem. Aerosols are released during mining, smelting and combustion (including volatilized elements and chemical aggregates) and they are deposited further away onto peats or lake sediments. The geochemical study of such proxies coupled with isotopic tracing of pollution sources and ore bodies provides an indirect, albeit fundamental view on such past human activities.

Here we present newly acquired high-resolution geochemical (major and trace elements), lead isotopic ratios (206-207-208Pb/204Pb) and sedimentological data on several peat records from the Romanian Carpathians that cover a time frame longer than 8000 years, with a special focus over periods with enhanced human impact on the environment, such as the Early Metal Ages, the Antiquity, Medieval and the recent past. We distinguish signatures related to the natural cycling of elements from the anthropogenic contributions due to natural resource exploitation (land, forestry), mining, and smelting activities. Together with existing geological, archaeological, and archaeometric evidences, our results provide the first comprehensive record on the long-term history of metal-use development in the Carpathian region. Through a comparison with records from other parts of Europe we document the existence of strong regional differences in the magnitude, temporal, as well as spatial shifts in our understanding of past emission sources. We therefore show that the existing picture of past pollution load and temporal variability at the European scale is incomplete because it is mainly based on western records without considering the long-term pollution inputs from southeastern Europe, a region with significant mineral endowment and long-lasting human impact on the environment driven by the early rise of agricultural and metal processing activities.

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